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PACKARD'S PHYLLOPOD CRUSTACEA.

A monograph of the phyllopod Crustacea of North America, with remarks on the order Phyllocarida.
By A. S. PACKARD, Jun. Author's edition,
extracted from the twelfth annual report of
the U. S. geological and geographical survey.
Washington, 1883. 298 p., 39 pl., map. 8°.

ALTHOUGH Professor Packard began publishing upon the Phyllopoda long ago, and has for several years been well known to be engaged upon a monograph of the North-American species, the bulk of the work just published, and the profusion of its illustrations, are a great surprise. It is the most extensive, and in many ways the most important, monographic contribution to American carcinology; and, however we may criticise the execution of the work, every student of the American fauna must feel grateful to the author for undertaking and accomplishing it.

The work is much more than a systematic monograph of North-American Phyllopoda, as the following table of contents will show: I. Classification of the living Phyllopoda, which includes the systematic description of the North-American species; II. Geological succession, including descriptions of the North-American fossil species; III. Geographical distribution; IV. Morphology and anatomy; V. Development, metamorphoses, and genealogy; VI. Miscellaneous notes on the reproductive habits of Branchipodidae, by Carl F. Gissler; VII. The order Phyllocarida, and its systematic position; VIII. Bibliography; Appendix, consisting of translations or abstracts by Gissler, of papers by C. T. von Siebold, on *Artemia fertilis* from Great Salt Lake, and on parthenogenesis in *Artemia salina*; and by Schmankewitsch, on the relation of *Artemia salina* to *Artemia Muehlhausenii* and to the genus *Branchipus*, and on the influence of external conditions of life upon the organization of animals. There is some confusion between the titles of the principal divisions, which are given above, and the table of contents in the work itself. Scarcely any of the titles are the same; and, in place of 'Miscellaneous notes on the reproductive habits of Branchipodidae,' we have, in the table of contents, 'Relation to their environment; habits,'—subjects nowhere treated under a separate heading; and all reference to the long appendix is omitted.

About a fourth of the entire work is devoted to the systematic account of the species and higher groups of Phyllopoda, regarded by Professor Packard as a sub-order of Branchiopoda, which is made to include Cladocera and Ostracoda also. The Phyllopoda are divided as

follows into families and sub-families, which include the number of recognized North-American genera and species nearly as indicated:—

LIMNADIIDAE:

Limnetinae (1 genus, 4 species).
Esteriinae (3 genera, 11 species).

APODIDAE (2 genera, 9 species).**BRANCHIPODIDAE:**

Branchipodinae (5 genera, 12 species).
Thamnocephalinae (1 genus, 1 species).

All the groups are described; nearly all the species are figured, many of them very fully; and important notes on variability and habits are given for some of the species. *Artemia gracilis* is treated more at length than any other species, and is made to include all the described North-American species; but, in regard to its relation to the European *A. salina*, there is certainly confusion, as the following paragraphs show.

"Upon comparing our species with the European, it is difficult to find good differential characters, as the portions of the body where specific differences would be expected to occur are liable to considerable variation. Upon comparing a number of females from Great Salt Lake with a number of females of the maleless generation from Trieste, Austria, received from Professor Siebold, there are really no differences of importance. Our *A. gracilis* (Verrill's *fertilis*) is slighter, with a smaller head; and perhaps the second antennae are a little slighter in build; I see no essential difference in the form of the ovisac, while the shape of the legs, especially the sixth endite, is essentially the same" (p. 331).

"On comparing a number of Salt Lake females with individuals of the same sex of the European *Artemia salina*, our species was found to be undoubtedly specifically distinct; the Utah specimens are slenderer, smaller, and the sixth endite of all the feet considerably slenderer and longer in proportion than in *A. salina*. The ovisacs were of the same proportion but slenderer, and the head is slighter and smaller in our American species" (p. 333).

Different conclusions on neighboring pages, in regard to the specific identity of closely allied forms, might be accounted for in a careless author; but differences like these in statements of observation betray inexplicable carelessness.

In the chapter on geological succession, a table of the geological and geographical distribution of the known fossil species is given, and also a diagram indicating the geological his-

tory of the orders of Crustacea, the sub-orders of Branchiopoda, and the families of Phyllopoda. It is said that this diagram "may also serve as a genealogical tree, showing the probable origin of the main divisions of the Crustacea;" but the genealogical part of the diagram consists simply of dotted lines connecting the points of first appearance in geological history of the Branchipodidae, Apodidae, and Cladocera, with the point of appearance of the Limnadiidae in the Silurian; the common stem from this point with the Ostracoda in the upper Laurentian; and the branchiopod stem thus formed, and continued to a hypothetical Protonauplius in the lower Laurentian, with the points of appearance of the Malacostraca, Phyllocarida, and Cirripedia. On what conceivable theory of evolution this would represent a possible, much less the probable, origin of the main divisions of the Crustacea, it is hard to imagine, and was probably not seriously considered by the author himself; for it is far less like a probable genealogical tree than the diagram on p. 448, illustrating the relations of the Phyllocarida to other Crustacea.

In the chapter on morphology and anatomy, Professor Packard discusses at length the morphology of the regions of the body and the appendages of Arthropoda in general, and of the crustacean limb in particular, and gives some account of the anatomy of the phyllopods, but adds very little to our previous knowledge of the anatomy of the group. The morphological discussion is an interesting contribution to the subject, and, with the numerous figures with which it is illustrated, will prove very useful, although most of the new nomenclature proposed for the regions of the body and appendages is very objectionable. Professor Packard says, "For the primary regions of the head (*sic*), the only scientific terms as yet in use are those proposed by Prof. J. O. Westwood, in Bate and Westwood's History of British sessile-eyed Crustacea (vol. i. p. 3). These are *cephalon* for the head, *pereion* for the thorax, and *pleon* for the abdomen; while the thoracic feet are termed *pereiopoda*, and the abdominal legs *pleopoda*; the three terminal pairs being called *uropoda*. As the names applied to the thorax and abdomen have no especial morphological significance, the Greek $\pi\epsilon\rho\alpha\iota\omega$, simply meaning *ulterior*, and $\pi\lambda\epsilon\omega$, more, we would suggest that the head be termed the *cephalosome*, the cephalic segments, *cephalomeres*, and the cephalic appendages in general, *protopoda*, the term '*cephalopoda*' being otherwise in use. The thorax of insects and of most Crustacea might be designated the

baenosome ($\beta\alpha\nu\omega$, to walk, locomotion), and the thoracic appendages, *baenopoda*, the segments being called *baenomeres*; while *urosome* might be applied to the abdomen, the abdominal segments being called *uromeres*. Westwood's term *uropoda* might be extended so as to include all the abdominal appendages." If mere names of parts are to be rejected, simply for want of 'morphological significance,' the language of the morphologist would soon become a meaningless jargon, to which it is near enough already; but, even as to 'morphological significance,' there appears to be little choice between the new and old terms. Bate, when first proposing the terms 'pereion'¹ and 'pleon,' expressly states that he derives the terms from $\pi\epsilon\rho\alpha\iota\omega$ ('to walk about') and $\pi\lambda\epsilon\omega$ (*navigo*). The proposed term 'protopoda' is quite as unfortunate as 'cephalopoda,' since 'protopodite' and 'protopod' are already in use for parts of crustacean appendages, the former even in the present work. The extension of the term 'uropoda' so as to make it synonymous with 'pleopoda' would also be unfortunate, since, as now employed, it is a very useful term to designate the modified caudal pleopoda, whether one, two, or three pairs.

In the chapter on development, metamorphoses, and genealogy, Professor Packard gives a short account of the nauplius form in Phyllopoda as an introduction to Dr. Gissler's interesting notes in the following chapter, and then briefly discusses the phylogeny of the group, in which he appears to find but one difficulty. He says,—

"The difficulty is (and this is a point apparently overlooked by Fritz Müller, Dohrn, Claus, and Balfour) to account for the origination of the phyllopods at all from any marine forms. The only explanation we can suggest, is that the phyllopods have arisen through Limnetis directly from some originally marine cladocerous type like the marine forms now existing, such as *Evadne*. We imagine that when a permanent body of fresh water became established, as, for example, in perhaps early Silurian times, the marine forms carried into it in the egg-condition, possibly by birds or by high winds, hatched young, which, under favorable conditions, changed into *Sida*, *Moina*, and *Daphnia*-like forms."

Professor Packard appears to have overlooked the difficulty of the eggs of any marine cladocerous type of animals surviving a sudden transfer from salt to fresh water, and the

¹ According to either Bate's or Packard's derivation, this would be more properly written *pereon*, as has sometimes been done, or even *pereon*.

absence of birds in the Silurian, which might well deter the boldest speculator from offering such an explanation ; but when we consider that permanent bodies of fresh water were undoubtedly formed by the gradual freshening of bodies of salt water cut off from the ocean, and that such bodies of fresh water usually had outlets connecting them with the sea, it is not surprising that Fritz Müller, Dohrn, and others should overlook a difficulty which is no greater for Phyllopoda than for other groups of freshwater animals.

In the chapter on his new order, *Phyllocarida*, and its systematic position, Professor Packard describes the anatomy and development of *Nebalia*, and discusses its fossil allies. The appendages of *Nebalia bipes* are described and fully figured, but on the internal anatomy very little that is new is given. The figures and text intended to elucidate the histology, like most of Professor Packard's similar work, leave much to be desired.

The bibliography consists of a hundred and thirty-eight titles, divided into four sections, — one for living and one for fossil Phyllopoda, and the same for *Phyllocarida*. The titles of many of the works referred to are omitted in the bibliography, which is evidently very incomplete ; but its incompleteness is not so annoying as the entire want of system in its arrangement, and the frequency of typographical errors.

Typographical errors are very numerous in all parts of the work ; and many of them cannot properly be charged to the proof-reader, who, however, ought to have corrected blunders like ‘Yahresbericht’ (several times) and ‘zooglocial,’ and the inexplicable punctuation of most of the bibliographical references in the systematic parts of the work. Errors due to careless writing or careless compiling are more common than purely typographical errors, and far more confusing. On p. 313 we have the following : “It is difficult to say whether this is a *Limnadia* or *Estheria*, as the description is too brief and inexact to enable us to determine the genus or species. It cannot be a *Limnadia*, and seems to approximate more closely to *Estheria* ; though it cannot belong to that genus.” On p. 335 it is said that ‘Schmankevitch’ found ‘*Branchinecta ferox* (Fischer sp.)’ transform by artificial means into *Artemia* ; but in reality he found an *Artemia* change into a *Branchinecta*, or into what he considered a *Branchipus*. On p. 337, ‘*Laborador examples*’ are said to have been taken ‘on the north side of Hamilton Inlet, Northern Greenland.’ On pp. 313 and 314 the species

of *Estheriinae* not recognizable are inserted between two species of *Eulimnadia* instead of at the end of the sub-family. Two paragraphs at the bottom of p. 349, under *Streptocephalus Seali*, should have been placed under *Chirocephalus Holmani*, on p. 352. On pp. 356 to 358 the genus *Leaia* is inserted between two species of *Estheria*.

The plates, perhaps the most valuable part of the work, are nearly all lithographs from the establishment of Thomas Sinclair & son, and are apparently accurate representations of the original drawings. The general figures, mostly drawn by Emerton and Burgess, are excellent. The figures of details, drawn by the author, are not always so satisfactory : the figures of the appendages of *Apus* and *Lepidurus*, for example, are very rudely drawn, and badly arranged on the plates. Unfortunately, the amount of enlargement of scarcely any of the figures is given.

S. I. SMITH.

SIR WILLIAM LOGAN.

Life of Sir William E. Logan, Kt., LL.D., F.R.S., F.G.S., etc., first director of the Geological survey of Canada. By BERNARD J. HARRINGTON, B.A., Ph.D., professor of mining in McGill university. Montreal, Dawson Bros., 1883. With steel portrait and numerous woodcuts. 432 p. 8°.

A LIFE of Logan will be greeted by all geologists as a fit companion for those which have recently appeared of his English colleagues, Lyell and Murchison. What they did for Great Britain, he did for his native Canada, and even more. He solved the most complicated geological problems in vast areas where no white man had ever trod before him. He forced his way through trackless forests, making his own surveys and maps as he proceeded, and, in spite of such difficulties, not only discovered the structure of a greater part of his own country, but gave to the world a new series of formations. The work of Murchison and Sedgwick he completed by carrying order and succession beyond the Silurian and Cambrian, into that chaos of still older rocks, thus rendering the soil of his beloved Canada forever classic in geological annals.

The author of the present memoir has given us Sir William's history almost in his own words. By means of judicious extracts from his voluminous correspondence and journals, chronologically arranged, we are presented with a charming picture of the man, as well as the *savant*, all the more faithful because it is unconsciously given. Here we see portrayed